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Annual Performance Report for

LITTLE SUSITNA RIVER COHO SALMON LIFE HISTORY AND ANGLER USE STUDIES

by

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ABSTRACT

A coho salmon, Oncorhynchus kisutch (Walbaum), creel census was conducted at two sites on the Little Susitna River for the third consecutive year. An estimated 2,965 coho were harvested in 7,720 angler-days of effort. Harvest and effort estimates decreased 59 and 11 percent, respectively, from 1982 to 1983. Coho spawning escapement was estimated at 2,666, a 60 percent decrease from 1982. Comparative escapement counts between helicopter and foot surveys established an aerial efficiency of 36 percent. The sport fishery harvested 53 percent of the total return.

Coho salmon life history studies were continued to determine run timing and movement through the sport fishery. Two capture and release tagging programs were conducted in the lower river utilizing Petersen disc tags and low frequency radio transmitters to monitor migration movements. No conclusions were reached because of small sample sizes.

Observations during experimental radio telemetry studies at Meadow Creek indicate that coho salmon which have just re-entered fresh water are more susceptible to stress than coho in more advanced stages of sexual maturation. Capture and tagging techniques during this period should be designed to minimize stress.

KEY WORDS

Southcentral Alaska, coho, sport fishery, management, escapement, life history, radio telemetry.

BACKCROUND

Coho salmon stocks of the northern Cook Inlet area experienced declines to very low levels in the early 1970's. An intense commercial fishery harvest in Cook Inlet and possible habitat degradation or loss are probable factors associated with these declines. Since coho salmon run timing through the commercial fishery in Cook Inlet coincides with that of all other species except chinook salmon, it is difficult to specifically manage coho salmon by manipulation of the mixed stock commercial fishery.

Therefore, management techniques have been conducted primarily through the regulation of the sport fisheries. Various techniques that are used include: protection of known spawning areas; restriction to weekend-only fishing; regulation of methods and means; and emergency closures when runs appear below average. As a result of these stringent regulations and more favorable environmental conditions, the northern Cook Inlet coho salmon populations began to increase substantially in 1975. Escapement counts in 1980 were the highest since these counts were initiated in the early 1960's.

As the northern Cook Inlet coho stocks increased, so too did sport fishing effort and harvest in the numerous freshwater streams of the Matanuska-Susitna Valley. Data from the Statewide Harvest Study (Mills, 1978-1983), an annual publication of sport fishing effort and harvest by area, indicate fishing effort has increased 24% from 1977 to 1982 within the Knik Arm and eastside Susitna River areas. Coho salmon harvest estimates increased 137% over the same period from 10,075 coho in 1977 to 23,843 in 1982.

There are approximately 25 streams within these areas that presently support a sport fishery for coho salmon. The most important stream within these areas and probably within the entire northern Cook Inlet area is the Little Susitna River. According to Statewide Harvest Study data, the Little Susitna is the second largest producer of freshwater caught coho salmon in the state. Only the Kenai River has a larger coho harvest. The Little Susitna provides an exceptional opportunity to harvest coho in an aesthetically pleasing manner, and the waterways physical features will accommodate substantial recreational use without excessive congestion. More than 70 miles of river are available to fishing by boat. Little Susitna coho are among the largest in northern Cook Inlet and are therefore highly prized by sport anglers. A detailed description of the river and the existing coho sport fishery was presented by Bentz (1983).

The Statewide Harvest Survey shows that total angling effort on the Little Susitna has increased 117% over 6 years from 11,063 angler-days in 1977 to 24,020 angler-days in 1982. Coho salmon harvest figures have also risen dramatically during this period with 3,415 coho taken in 1977, rising to 7,116 in 1982 which represents a 108% increase. Substantial increases in fishing effort are expected to continue as access road improvements to the lower river are completed and other support facilities such as campgrounds and boat launch sites are constructed.

The importance of the Little Susitna River and its potential for recreation and fishing opportunities was acknowledged by the Department of Natural Resources when they included and granted it special protective status in the Land Use Plan for Public Lands in the Willow Sub-Basin (Dept. of Natural Resources, 1982). These land use guidelines emphasize retention of all public lands within the Little Susitna corridor, with fish and wildlife and recreation as the primary land uses.

The value placed on this system as a high quality, productive sport fishery is reflected in the Plan for Supplemental Production of Salmon and Steelhead for Cook Inlet Recreational Fisheries (1981). This plan lists a coho stock enhancement program on the Little Susitna as the number one priority. In response to this priority the Fisheries Rehabilitation, Enhancement and Development (F.R.E.D.) Division began a brood stock enhancement and egg take program in 1981, with 3,113 eggs collected. The eggs were incubated at the Big Lake Hatchery complex and nearly 3,000 coho fry were released into the river in 1982. This program was expanded in 1982, when 500,800 eggs were taken from Little Susitna coho and the fry released in 1983. During 1983, 500,000 coho eggs were collected. The fry will be released into the system in 1984. An additional 56,000 eggs were collected and are being incubated at the Fort Richardson Hatchery facilities. These fish will be raised to smolt size for release in 1985.

A statistically designed coho salmon creel census was initiated in 1981 and expanded during 1982 to determine harvest and effort estimates for this rapidly expanding fishery. This expanded census program was continued during 1983. In addition to the creel census program, a life history study was initiated in 1982 and continued in 1983 to identify various aspects of the Little Susitna coho salmon adult population which included: run timing and movement through the sport fishery; migration rates and important holding areas; and distribution and magnitude of spawning.

To accomplish these objectives the study was divided into three segments. Two capture and release tagging programs were conducted simultaneously, beginning in late July. Adult coho salmon were captured in the lower river where sport fishing effort began. The majority of these fish were tagged with a numbered Petersen disc and released. Run timing and migration rate estimates were determined by recapture of these fish in the upstream sport fishery and monitored by the two creel census programs.

A second group of adult coho salmon were tagged with a numbered Petersen disc and a low frequency radio transmitter prior to release. Upstream migration of these radio tagged fish was monitored twice weekly with radio receivers to determine rates of migration through the sport fishery and to identify important holding or milling areas and mainstream and tributary spawning areas.

The third segment of this coho life history study involved escapement surveys at major spawning areas to enumerate the spawning population. Recovery of radio tagged-fish was also attempted for examination of

tagging effects on the fish and to determine if these fish had spawned successfully.

An experimental coho salmon radio-tagging study was conducted in September at the Big Lake Hatchery on Meadow Creek. Three different radio-tagging procedures were tested in an attempt to identify which procedure was least stressful to coho salmon. Tagged coho were held within a double weir structure in Meadow Creek for observation. Movement of radio-tagged coho was monitored with receivers after the structure was removed.

Table 1 lists all species mentioned in this report and Figure 1 is a map of the study area.

RECOMMENDATIONS

1. The coho salmon creel census should be continued at the Burma Road and Parks Highway to determine angler effort and harvest.

2. Coho salmon life history studies should be continued to determine run timing, migration rate through the fishery and major spawning areas.

3. Escapement surveys should be continued for development of future enhancement programs and management plans.

OBJECTIVES

1. To determine abundance, distribution and run timing of coho salmon in the Little Susitna River from July to October.

2. To determine harvest levels and fishing effort for coho salmon between July and September and identify various biological characteristics of the population.

3. To make recommendations for proper management of the wild stock and identify potential enhancement opportunities.

TECHNIQUES USED

Creel Census Program

The Little Susitna coho salmon creel census was statistically designed to estimate harvest and effort. Since the area open to coho salmon fishing on the Little Susitna River encompasses 70 river miles, it was necessary to conduct a creel census at both major access points which are 42 river miles apart. These access points are referred to throughout this report as the Burma Road and Parks Highway, which access the lower and upper river fishing areas, respectively. Catch and effort

Table 1. List of Common Names, Scientific Names and Abbreviations.

Common Name	Scientific Name and Author	Abbreviation
Chinook salmon	Oncorhynchus tshawytscha (Walbaum)	KS
Chum salmon	Oncorhynchus keta (Walbaum)	CS
Coho salmon	Oncorhynchus kisutch (Walbaum)	SS
Pink salmon	Oncorhynchus gorbuscha (Walbaum)	PS
Sockeye salmon	Oncorhynchus nerka (Walbaum)	RS

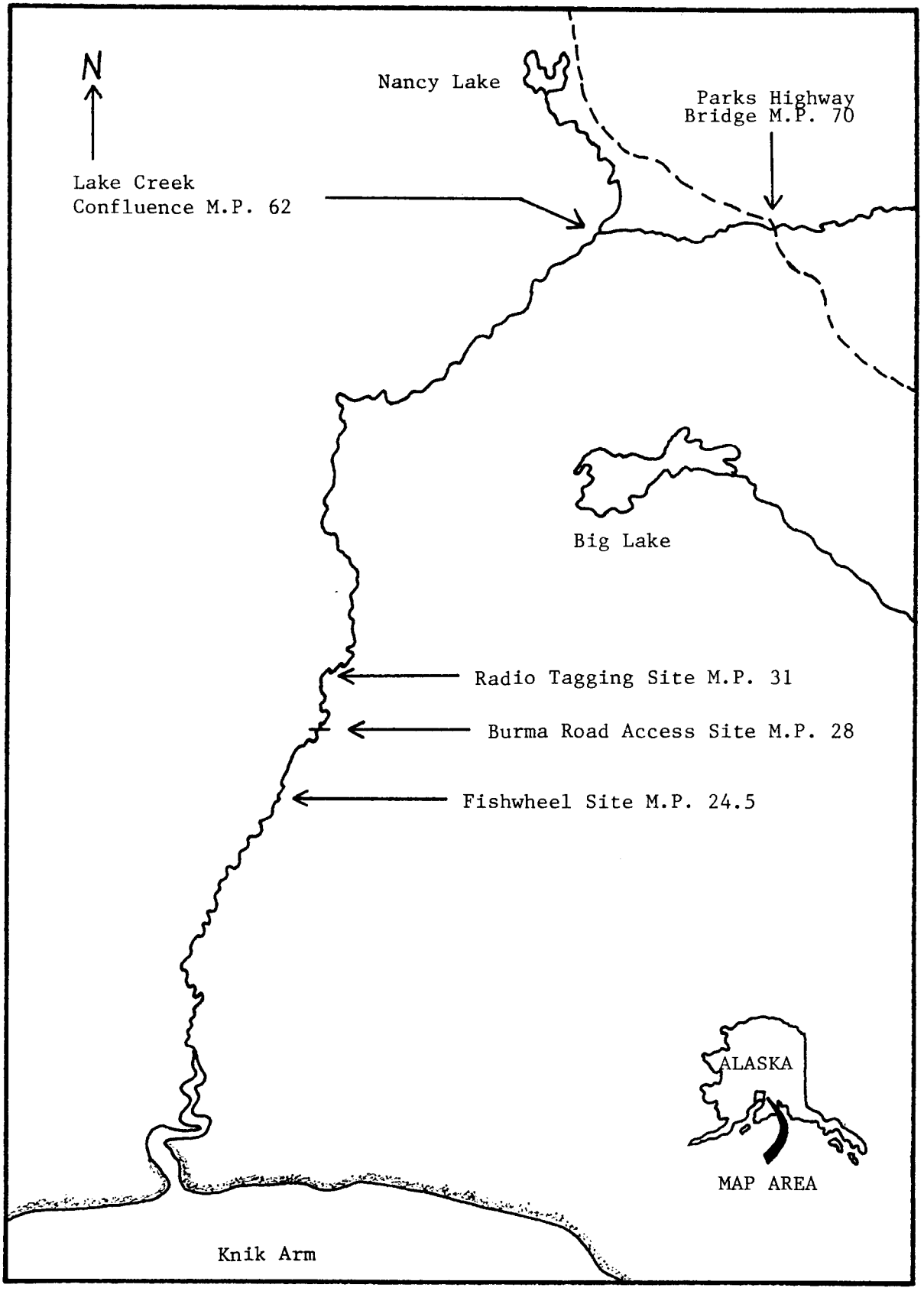

Figure 1. Area Map of the Little Susitna River Open to Salmon Fishing, M.P. 0 - M.P. 70.

estimates were calculated separately for each access point and then summed.

The census at the Burma Road access site was conducted from July 16 through September 5. The sampling day was divided into four 4-hour periods between the hours of 6:00 am and 10:00 pm. Seven random, preselected periods were sampled during 4 weekdays of each week. All four periods were sampled on each weekend day and holiday.

Angler counts by foot were not conducted at the Burma Road access site as had been done in previous years because the majority of shore anglers began fishing outside the established count area. This resulted in incorrect estimates of total fishing effort and harvest. All completed anglers were interviewed as they exited the fishery at the access site and a direct expansion was utilized to generate these estimates in 1983. Angler counts were conducted by boat from the Burma Road access site to estimate harvest and effort by anglers that boated across the marine waters of Knik Arm from Anchorage and fished in the lower river, 4 to 12 miles below the access site. These boat counts were conducted at randomly selected times five times weekly.

The census at the Parks Highway access site was conducted from July 30 through September 5. The sampling day was identical to that used at the Burma Road. Nine random, preselected periods were sampled during 3 weekdays of each week while all four periods were sampled on each weekend day and and holiday. Randomly scheduled angler counts were conducted during sampling periods within areas that received the greatest fishing intensity.

Only completed anglers were interviewed at the two access sites. Information collected from anglers included: number of hours fished; number, species and sex of fish caught; and whether they were boat or shore anglers. All coho salmon were weighed to the nearest 0.1 pound and measured from tip of snout to fork of tail and from mid-eye to fork. Both measurements were recorded to the nearest 0.5 cm. Scales were collected from all coho salmon and placed in coin envelopes with the appropriate biological data recorded on each envelope. The scales were mounted on gum paper and then pressed onto plastic acetate. Age determinations were accomplished using a Bruning Model 200 microfiche reader. The European method was used to denote age classes.

All anglers, both completed and incompleted, who boated across Knik Arm to fish in the lower river were interviewed during the downstream angler counts from the Burma Road. Only number of hours fished and number, species and sex of fish caught were collected to estimate harvest and effort for this group of anglers. Coho salmon harvested by these anglers were not physically examined to obtain biological information because of the inconvenience caused by census personnel boarding boats.

Life History Studies

An aluminum fishwheel was utilized to capture adult coho salmon for the Petersen disc tagging program. The design was similar to fishwheels used on the Susitna River to capture adult salmon (ADF&G, Susitna Hydro

Aquatic Studies, 1981). Each of the two baskets had an average length, width and depth of 6.0, 5.0 and 2.3 feet, respectively. The fishwheel was equipped with an adjustable axle which allowed the baskets and paddles to be raised or lowered according to fluctuations in water depth. The wheel was located 3.5 miles below the Burma Road access site at river mile (M.P.) 24.5. Fishwheel operation began on July 22 and continued through August 26. Captured coho were removed from the fishwheel holding tank and immediately placed in a canvas tray. With the fish immobilized in the tray, the sex was determined, a snout to fork measurement was recorded and a yellow, 1-inch diameter numbered tag was attached between the interneural bones just below the dorsal fin. The fish were returned to the water immediately after tagging and held lightly by the caudal peduncle while recovering.

Floating, nylon multifilament gill nets 60 ft x 36 meshes deep with a 4 1/2-inch bar measure were also used to collect adult coho salmon in the lower river for Petersen disc tagging. The gill nets were set from August 3 through August 25 in various pools utilized by coho as holding areas between M.P. 20 and M.P. 31. Coho salmon would become entangled by the snout and would not actually be gilled in the mesh. When fish became entangled they were immediately removed and tagged with a disc. Tagging procedures were identical to those used at the fishwheel with the exception that a pink disc was used for differentiation purposes.

Coho salmon tagged with both Petersen discs and a low frequency radio transmitters were captured on August 2 and 3 between M.P. 31 and 32. The majority of these fish were captured with the same 4 1/2-inch gill nets used in the Petersen disc netting program. The remaining coho were captured with a 150 ft x 8 ft seine net with a 2-inch bar measure mesh.

The Smith-Root low frequency radio telemetry equipment and tagging techniques used are described in detail by Bentz (1983). Esophogeal implants were utilized exclusively during this year's study. None of the coho were anesthetized prior to transmitter insertion. Fish captured by seine net were tagged and returned to the river immediately. Coho salmon captured by floating gill net were placed in an 8 ft x 3 ft holding pen set in the river. Individual coho were removed from the holding pen, tagged and returned to the pen for observation for approximately 30 minutes prior to release.

Migration movements were monitored twice weekly using radio receivers from August 3 through August 18, and also on August 30. When the majority of radio-tagged coho were concentrated in the lower river, tracking was conducted by boat to determine upstream movement. Later, when the tagged fish had distributed themselves throughout the river and low flow conditions made boat tracking impractical, tracking was conducted by low level flights. An automatic data logger was operated from the creel census field camp which was located 1 river mile upstream from the Burma Road access site. The printout tape was checked daily to identify passage of radio-tagged coho.

Little Susitna River coho salmon spawning populations were enumerated by foot surveys within established index areas on September 28. These

index areas were surveyed again on October 3 by helicopter to compare foot and aerial escapement counts.

Experimental radio-tagging studies on coho salmon at the Big Lake Hatchery were conducted on September 13 and 15. Adult male coho were captured by seine nets between two weirs set 75 feet apart in Meadow Creek and transferred to holding pens prior to tagging. Two groups of coho salmon were tagged using the esophogeal/stomach insertion technique. Ten coho were anesthetized with methanesulfonate (MS-222) prior to transmitter insertion while another group of 10 coho were tagged without anesthetic.

A third group of 10 coho were anesthetized and tagged using a subcutaneous surgical implant technique. With the anesthetized coho held in the tagging tray, a 2 to 3-cm incision was made just through the skin above the lateral line and anterior to the dorsal fin. A 3/4-inch diameter sharpening steel was inserted into the incision and pushed forward approximately 10 cm separating the skin from the underlaying muscle tissue. A radio transmitter was then inserted into the cavity created by the steel. The incision was sutured with noncapillary, non-absorbable suture material and a #6 3/8 circle cutting suture needle. The transmitter antenna exited the cavity through the incision to trail along the body.

A fourth group of eight coho were anesthetized and tagged with a Petersen disc only, to identify any detrimental effects due to the anesthetic and handling. All coho were placed into holding pens immediately after tagging for observation. When the fish resumed normal swimming behavior they were released into Meadow Creek within the double weir structure.

Several radio tagged coho escaped from the structure prior to its removal from Meadow Creek on October 10. Migration movements were monitored from September 23 through October 25 by foot, boat and low altitude flights.

FINDINGS

Creel Census Program

The total coho salmon sport harvest at the Little Susitna River in 1983 was estimated at 2,965 fish with 7,720 angler-days of effort (Table 2). Harvest per hour and per angler-day averaged 0.09 and 0.38, respectively. The 1983 coho harvest declined 59.4% from the 1982 harvest of 7,308 (Bentz, 1983) while total effort in 1983 fell 10.9% from 8,666 angler-days estimated during the 1982 census (Table 3). The 1983 harvest estimate is the lowest recorded since 1977, when coho salmon harvest levels were first estimated through the Statewide Harvest Study (Mills, 1979-1983).

Anglers at the Berma Road access site harvested 1,598 coho salmon during 3,639 angler-days, which represents 53.9 and 47.1% of the river's total harvest and effort, respectively. Harvest per hour and angler-day was

Table 2. Harvest and Effort Data of the Little Susitna River Sport Fishery for Coho Salmon in 1983.

	Burma Road				Anchorage*		Parks Highway				
	Shore		Boat		Boat		Shore		Boat		
	WD**	WE	WD	WE	WD	WE	WD	WE	WD	WE	TOTAL
Harvest	344	105	536	613	703	328	43	22	157	114	2,965
Effort-Angler-Days	880	743	960	1,056	568	580	805	807	636	685	7,720
$\bar{x}$ Hours Fished	3.2	3.3	5.0	5.6	5.9	6.4	1.7	1.8	4.6	4.5	4.1
Fish/Hour	0.12	0.04	0.11	0.10	0.21	0.09	0.03	0.02	0.05	0.04	0.09
Fish/Angler-Day	0.39	0.14	0.56	0.58	1.24	0.57	0.05	0.03	0.25	0.17	0.38

* Anglers from Anchorage that boated across Knik Arm during high tide to fish in the lower portion of the river.

** WD = Weekday
WE = Weekend

Table 3. Little Susitna River Coho Salmon Harvest, Effort and Catch Per Unit Effort, 1981-1983.

	Year	Burma Road Anglers*	Anchorage Anglers	Parks Highway Anglers*	Total
Harvest	1981	1,379	3,100	743	5,222
	1982	2,580	1,817	2,911	7,308
	1983	1,598	1,031	336	2,965
Effort-Angler-Days	1981	993	1,673	1,714	4,380
	1982	2,262	1,087	5,317	8,666
	1983	3,639	1,148	2,933	7,720
$\bar{x}$ Hours Fished	1981	4.5	4.8	2.6	4.3
	1982	4.1	4.8	3.6	4.0
	1983	4.4	6.2	3.0	4.1
Fish/Hour	1981	0.31	0.38	0.17	0.31
	1982	0.28	0.35	0.15	0.21
	1983	0.10	0.15	0.04	0.09
Fish/Angler-Day	1981	1.39	1.85	0.43	1.19
	1982	1.14	1.67	0.55	0.84
	1983	0.44	0.90	0.11	0.38

* Includes both shore and boat anglers.

0.10 and 0.44, respectively. Of the total effort and harvest expended in the Burma Road area, boat anglers fished 2,016 days and harvested 1,149 coho while shore anglers harvested 449 coho in 1,623 angler-days.

Anglers that boated across Knik Arm from Anchorage during high tide to fish in the lower river harvested 1,031 coho salmon during 1,148 angler-days, 34.8 and 14.9% of the entire river's respective harvest and effort totals. Harvest per hour and angler-day was 0.15 and 0.90, respectively.

Parks Highway anglers harvested 336 coho with 2,933 angler-days of effort. These figures represent 11.3 and 38.0% of the respective harvest and effort totals for the entire river. Harvest per hour and per angler-day was 0.04 and 0.11. Boat anglers harvested 271 coho salmon in 1,321 angler-days while shore anglers fished 1,612 days and harvested 65 coho. Anglers that chartered comprised 30.2% of the total Parks Highway boat fishing effort. These anglers were usually transported to a downstream fishing area, dropped off and picked up again later in the day, although charter operators would sometimes remain with their clients and guide them to different areas. Chartered boat anglers experienced a slightly higher coho harvest per angler-day than private boat anglers because their average hours fished per day was higher. A coho harvest per hour of 0.042 was exactly the same between the two boat angler groups.

An estimated 303 angler-days or 3.9% of the total effort was recorded for anglers which floated from the Parks Highway to the Burma Road in 1983. These anglers harvested 113 coho salmon or 3.8% of the total coho harvest. These figures reflect a slight increase from 1982 estimates when floaters comprised 2.3 and 2.2% of the total effort and harvest, respectively (Bentz, 1983).

Although total fishing effort on the Little Susitna River decreased by 946 angler-days from 1982 to 1983, effort at the Burma Road rose by 1,377 angler-days, an increase of 60.8% during the same period (Table 3). Effort has increased 266% since 1981, making this the fastest growing segment of the coho salmon sport fishery on the entire river. Increased effort at the Burma Road is a direct result of the recent improvements to the road that accesses this portion of river. With further road improvements scheduled for 1984 and support facilities such as campgrounds and boat launch sites in the planning stages, fishing effort in the lower river is expected to continue to increase substantially.

While fishing effort has steadily increased at the Burma Road, coho salmon catch per unit effort, expressed as harvest per hour, has decreased substantially (Figure 2). Anglers experienced a slight drop from 1981 to 1982 of 0.31 to 0.28 fish per hour, respectively. However, 1983 coho catch rates fell to 0.10 fish per hour. Anglers which crossed Knik Arm to fish in the lower river also experienced a drop in harvest rate (Table 3).

Harvest and effort estimates at the Parks Highway are only comparable between 1982 and 1983 because the 1981 census was terminated prematurely

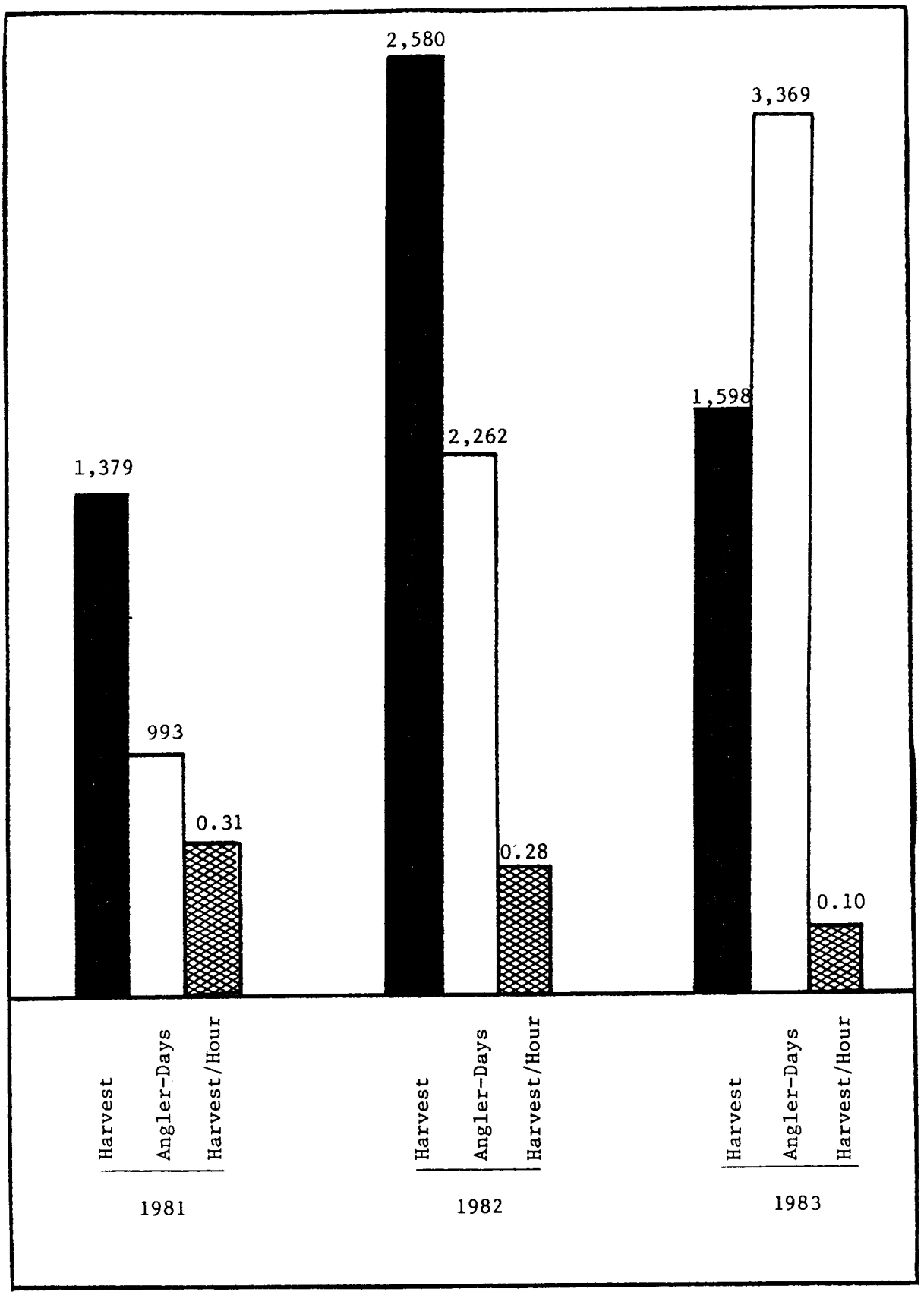

Figure 2. Harvest, Effort and Harvest Per Hour of Coho Salmon at the Burma Road Access Site, 1981-1983.

on August 24 during the peak of the upstream fishery. Angling effort in 1983 decreased 44.8% from 1982 estimates, while the coho salmon harvest dropped 88.5% from the previous year. The significant reduction in effort in 1983 was probably due to consistently poor catch rates in the Little Susitna River, causing many potential anglers to fish elsewhere. Coho salmon harvest per hour at the Parks Highway declined sharply from 0.15 fish per hour in 1982 to 0.04 in 1983, very similar to the drop observed in the lower river fishery (Table 3).

Weekly fishing effort in 1983 is presented in Table 4 for Burma Road, Anchorage and Parks Highway anglers. Peak effort by Anchorage anglers occurred during the week of July 16-22, the first week of the lower river creel census. Burma Road angling effort peaked the following week, July 23-29. The highest fishing effort in 1983 occurred 2 to 3 weeks earlier than the peak effort period during 1982, which was during August 7-13 for both angling groups in the lower river (Bentz, 1983). Angling effort at the Parks Highway reached its apex during the first week of the coho salmon creel census on July 30 - August 5, which was also 2 weeks earlier than the peak effort in 1982. High angling effort early in the season at the Parks Highway was caused by the availability of large numbers of sockeye salmon concentrated at the Lake Creek confluence. Very few coho were available in the upper river area at this time.

Weekly harvest and sex ratios are given in Table 5. The peak harvest period for Burma Road and Anchorage anglers, July 23-29, occurred 2 weeks earlier than the maximum weekly harvest at the Parks Highway during August 6-12. This 2-week delay between the lower and upper river areas was observed during the 1982 census also, but occurred 1 week earlier in 1983.

Figure 3 provides a comparison of coho salmon harvest rates by weekly period at the Burma Road and Parks Highway fisheries during 1982 and 1983. Burma Road catch rates in 1983 rose during the first 2 weeks of the census, similar to 1982. However, while 1982 catch rates continued to climb to the highest point of the entire season during the third week, catch rates began to decline in 1983. This decline continued until the fourth week when they reached the lowest point of the season - 0.23 coho salmon per angler-day. Harvest rates then began to climb again and reached the seasonal high of 0.61 coho per angler-day during the sixth week. Reasons for this bimodal harvest rate curve are unclear at this time.

Preliminary data analysis of coho salmon caught by fishwheels in the Susitna and Yentna Rivers also revealed a distinct bimodal pattern in catch rates during 1983 (ADF&G, Susitna Hydro Aquatic Studies, 1984; in press). The period of decreasing catch rates occurred on approximately the same dates at all four fishwheel stations. Examination of discharge data for both rivers (USGS, 1984; in press) shows that flood stage flows occurred at the same time as the drop in catch rates. We believe alteration in coho salmon migrational movements in response to variations of discharge was the major factor causing the bimodal catch distribution.

Table 4. Little Susitna River Coho Salmon Fishing Effort Percentages by Weekly Period in 1983.

	7/16-7/22	7/23-7/29	7/30-8/5	8/6-8/12	8/13-8/19	8/20-8/26	8/27-9/5	Total
Burma Road Anglers*	633	1,234	1,106	397	142	36	91	3,639
%	17.4	33.9	30.4	10.9	3.9	1.0	2.5	100.0
Anchorage Anglers	365	287	256	96	62	54	28	1,148
%	31.8	25.0	22.3	8.4	5.4	4.7	2.4	100.0
Parks Highway Anglers*	No Census	No Census	968	651	640	346	328	2,933
%	...	...	33.0	22.2	21.8	11.8	11.2	100.0
Total Anglers	996	1,513	2,331	1,143	849	440	448	7,720
%	12.9	19.6	30.2	14.8	11.0	5.7	5.8	100.0

* Includes both boat and shore anglers.

Table 5. Little Susitna River Coho Salmon Harvest Percentages and Sex Ratios by Weekly Period in 1983.

	7/16-7/22	7/23-7/29	7/30-8/5	8/6-8/12	8/13-8/19	8/20-8/26	8/27-9/5	Total
Burma Road Harvest*	286	692	427	91	50	22	30	1,598
%	17.9	43.3	26.7	5.7	3.1	1.4	1.9	100.0
Sex Ratio Male:Female	0.71:1.0	0.70:1.0	1.35:1.0	1.9:1.0	0.75:1.0	1.36:1.0	0.85:1.0	0.91:1.0
Anchorage Anglers Harvest	293	397	73	121	112	22	13	1,031
%	28.4	38.5	7.1	11.7	10.9	2.1	1.3	100.0
Sex Ratio Male:Female	0.58:1.0	0.68:1.0	1.33:1.0	1.08:1.0	0.63:1.0	1.50:1.0	2.0:1.0	0.74:1.0
Parks Highway Harvest*	No Census Conducted	No Census Conducted	14	90	87	55	90	336
%	...	...	4.1	26.8	25.9	16.4	26.8	100.0
Sex Ratio Male:Female	...	...	1.0:1.0	1.07:1.0	1.38:1.0	1.09:1.0	1.17:1.0	1.15:1.0
Total Harvest	579	1,089	514	302	249	99	133	2,965
%	19.6	36.7	17.3	10.2	8.4	3.3	4.5	100.0
Sex Ratio Male:Female	0.67:1.0	0.69:1.0	1.35:1.0	1.19:1.0	0.82:1.0	1.25:1.0	1.04:1.0	0.88:1.0

* Includes both boat and shore anglers.

Flow data for the Little Susitna River were analyzed to determine if increased discharge occurred during the period of decreasing catch rates at the Burma Road. Average weekly discharge did increase from 321 cfs during the third week to 616 cfs during the fourth week of the census when catch rates were decreasing (USGS, 1984; in press). However, while catch rates began to increase during the fifth and sixth weeks of the census, a concomitant increase in discharge was observed. It seems unlikely that variations in discharge altered migration movements of coho salmon in the Little Susitna or influenced the Burma Road harvest rate.

Coho salmon harvest rates by weekly period at the Parks Highway exhibited a steady increase in coho per angler-day throughout the 5-week creel census in 1983. During the first week of the census, the coho per angler-day harvest was 0.01 and gradually increased to 0.27 during the last week of the census.

The male to female sex ratio of coho salmon harvested at the Burma Road sport fishery was 0.91:1.0, 0.74:1.0 for Anchorage anglers and 1.15:1.0 at the Parks Highway. The combined sex ratio of all coho harvested in 1983 was 0.88:1.0. The combined sex ratios at the Burma Road and Parks Highway in 1981 and 1982 were 1.13:1.0 and 0.69:1.0, respectively (Bentz, 1982-1983). Weekly sex ratios at the Burma Road followed a similar pattern in 1982 and 1983. During the beginning of the census the harvest is predominately female coho. As the season progresses a gradual shift to a male dominant harvest occurs. This seasonal shift towards the harvest of more males than females was also observed in the Anchorage anglers' harvest. The small number of coho observed during the 1983 Parks Highway census precludes any comparison with 1982 sex ratios.

Sex ratios were compared for gutted and ungutted coho at both census locations from 1981 through 1983. It was assumed that the sex of gutted fish was always correct because the angler observed the sex products as they were removed during the cleaning process. Census personnel determined the sex of ungutted fish by examination of external sexual characteristics. A chi-square test ($P=0.05$) was used to determine significant differences between the two sex ratios. Only two tests showed a significant difference between gutted and ungutted sex ratios; at the Burma Road in 1981 and the Parks Highway in 1983. In both instances the sample size was less than 50 fish for the entire season which was too small for a valid comparison.

Although there were no statistical differences between gutted and ungutted sex ratios when data from 1981 through 1983 were combined, there was a tendency for census personnel at the Burma Road to identify males as females. Most coho harvested in the lower river have just re-entered fresh water and exhibit few of the external sexual characteristics that become more pronounced as maturation advances. The opposite situation occurred at the Parks Highway. Census personnel tended to identify females as males. When coho reach the upper river, 70 miles from salt water, they are often in advanced stages of sexual maturation. Some female coho had developed external characteristics similar to those of males and they were misidentified.

Age composition of Little Susitna River coho salmon is strongly dominated by Age 2.1 or 4-year-old fish. Of the 99 coho aged by scale analysis in 1983, 90.9% were Age 2.1, with the remaining 9.1% being Age 1.1. In 1981 and 1982, 92.6 and 97.7% of the respective coho aged were Age 2.1 (Bentz, 1982-1983).

A comparison of mid-eye to fork length and weight data of coho salmon harvested at the Burma Road and Parks Highway in 1983 is presented in Table 6. Male coho were slightly longer and heavier than females. Larger lengths for females at the Parks Highway is probably due to an inadequate sample size. Males harvested in previous years at the Burma Road sport fishery were also larger and heavier than females. The average length and weight of coho harvested in 1981 and 1983 are nearly identical (Bentz, 1982).

Anglers at the Little Susitna River also harvested an estimated 1,721 sockeye salmon and 211 chum salmon during the creel census. Boat anglers accessing the river at the Parks highway harvested 1,644 sockeye and 64 chum salmon. These anglers fished at the Lake Creek confluence, 8 river miles below the Parks Highway bridge and harvested nearly 95% of the sockeye salmon caught throughout the river. Burma Road anglers caught 77 sockeye and 147 chum salmon. Total seasonal harvest was presumed to be at least double these figures as the creel census programs began during the peak of migrations for both species. Over 75% of the estimated sockeye harvest at the Parks Highway occurred during the first week of the census and 83% of the chums harvested at the Burma Road were caught during the first 2 weeks. Harvest of both species dropped sharply during succeeding weeks.

Life History Studies

Escapement surveys during previous years have determined that the majority of coho spawning in the Little Susitna River occurs from the Edgerton Parks bridge at M.P. 98 downstream to the Shrock Road bridge at M.P. 85. Limited spawning occurs from M.P. 75 downstream to the Lake Creek confluence at M.P. 62. In 1983 escapement surveys were conducted by foot from M.P. 98 downstream to M.P. 79. A total of 2,666 coho were observed within this reach. The highest spawning concentrations were observed between M.P. 89 and M.P. 85 with 321 coho per river mile. This area contained the highest number of coho during the 1982 escapement survey when 420 coho per river mile were enumerated (Bentz, 1983).

On October 3 a coho escapement survey was conducted by helicopter from M.P. 99 to M.P. 70 at the Parks Highway bridge to develop estimates of observation efficiency between aerial and foot surveys. Efficiency estimates had been developed by Watsjold (1974) for chinook salmon aerial surveys, but it was not known if these estimates were applicable for coho salmon. Only 959 coho salmon were observed during the helicopter survey, which is 36% of the foot survey total of 2,666 coho. This aerial efficiency estimate is considerably lower than the 55 to 70% efficiency estimates for chinook salmon. The lower efficiency could be due to the smaller size of coho salmon, making them more difficult to observe from the air. Another factor may be that coho salmon tend to school or concentrate on the spawning grounds more so than chinook which

Table 6. Comparison of Mid-Eye to Fork Length and Weight Data of Coho Salmon Harvested at the Burma Road and Parks Highway Access Sites of the Little Susitna River in 1983.

Location	Length (cm)				Weight (lb)			
	n	$\bar{x}$	$\pm$ SD	Range	n	$\bar{x}$	$\pm$ SD	Range
Burma Road								
Females	222	58.33	3.31	44.0-67.0	78	7.44	1.38	2.0-10.0
Males	195	59.56	4.06	42.0-71.0	75	8.34	2.09	0.90-12.0
Combined	417	58.91	3.72	42.0-71.0	153	7.88	1.82	0.90-12.0
Parks Highway								
Females	9	60.56	1.94	58.0-64.0	9	8.72	0.94	7.0-10.0
Males	23	60.17	5.58	45.0-66.0	24	9.42	2.51	4.0-13.0
Combined	32	60.28	4.81	45.0-66.0	33	9.23	2.20	4.0-13.0

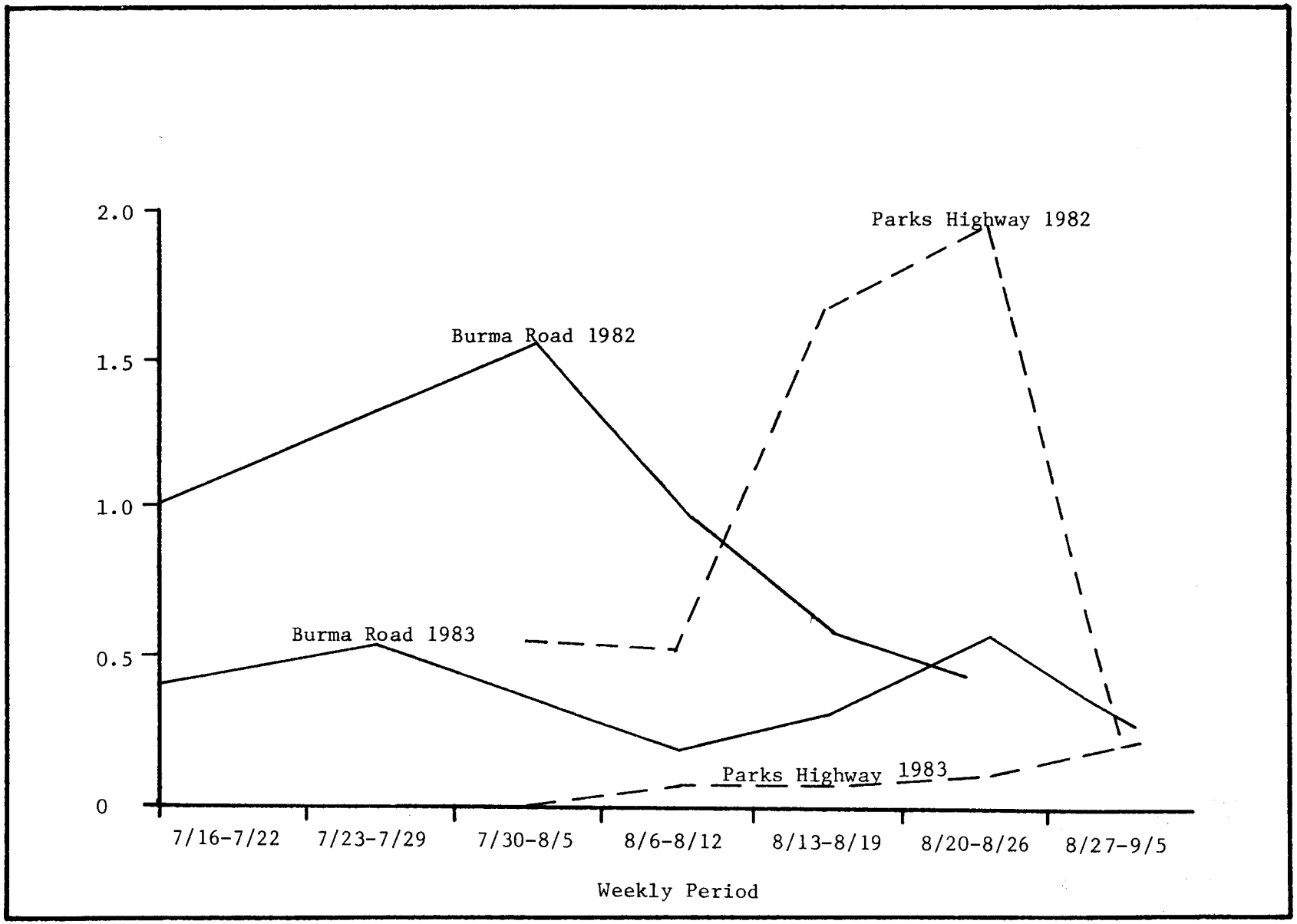

Figure 3. Coho Salmon Harvest Rates by Weekly Period at the Two Access Sites of the Little Susitna River in 1982 and 1983.

also creates counting difficulties. These comparative coho escapement surveys will be continued in future years to verify the 1983 efficiency estimates.

Prior to 1983, complete escapement surveys were conducted in 1978, 1981 and 1982 with 6,156, 6,750 and 6,800 coho enumerated, respectively. Surveys were not conducted in other years because of persistent high water and poor counting conditions during the coho spawning period. The 2,666 coho escapement in 1983 is the lowest recorded on the Little Susitna River. Coho escapement in 1983 declined 60.8% from 1982 escapement estimates and a concomitant decrease of 59.4% was observed in coho harvest by the sport fishery with similar effort in both years. This parallel decrease in harvest and escapement may be merely coincidental or there may be a predictable relationship that will allow prediction of coho salmon escapement by analysis of harvest and effort trends during the sport fishery. If such a relationship occurs it would provide important in-season management information.

The total coho salmon return to the Little Susitna River in 1983 was estimated at 5,635, of which the sport fishery harvested 2,965 or 53% of the return. If the Cook Inlet commercial fishery harvested Little Susitna coho salmon at the same rate as northern Cook Inlet sockeye salmon have been harvested in recent years, which is often two out of three, or 66%, then the total coho production for 1983 would be 16,900 fish. Combined harvest by the commercial and sport fisheries could have reached 14,235 which is 84% of the total run.

Adult coho salmon were captured by the fishwheel located at M.P. 24.5 from July 22 through August 26. A total of 21 coho salmon were tagged and released during this period. Twelve sockeye, 35 chum, 4 pink and 2 chinook salmon were also captured. Peak capture rates occurred during the third week of the creel census, July 30 through August 5, when 14 coho were tagged. Catch rates at the Burma Road sport fishery dropped from 0.56 coho per angler-day to 0.39 coho per angler-day during this same period.

Low flow conditions, which persisted during most of the tagging program, was felt to be the major cause for the poor capture rate of coho salmon at the fishwheel. Flows were 50 to 66% lower than those recorded in 1981 and 1982 during the same period (USGS, 1981-1982). The river was low and the water unusually clear during the period when the majority of coho salmon migrated past the fishwheel. Groups of coho were observed moving upstream toward the fishwheel, stopping just short of it and then moving in a wide arc around it before continuing upstream. Most of the coho were captured at night when visibility was reduced.

Two of the 21 coho released were recaptured in the sport fishery. One fish migrated 6.5 miles upstream prior to recapture 3 days after release at the fishwheel. The other coho traveled upstream 15 miles in 6 days before being recaptured. A tagged sockeye salmon migrated 37 miles in 5 days before being recaptured near the Lake Creek confluence.

Thirty-nine coho salmon were captured by floating gill nets from August 3 through August 25 in the lower river. Four chum and two pink salmon

were also tagged and released. None of these tagged coho were recaptured in the sport fishery. Coho salmon captured by gill net had an average mid-eye to fork length of 58.9 cm, which was identical to the combined male-female average length of coho harvested in the Burma Road sport fishery. The average length of the 21 coho captured in the fishwheel was 10.7 cm less than the gill net and sport caught coho. Reasons for this apparent selective capture of smaller coho by fishwheel is unclear. However, it is recognized that the small sample size of fish captured by fishwheel could cause such a disparity.

Coho salmon captured by gill and seine nets for the radio telemetry study were collected on August 2 and 3 between M.P. 31 and 32. Coho captured in the fishwheel were not utilized for the radio study as initially planned because most of the fish were below the 60 cm mid-eye to fork length established through other studies as the minimum length to ensure against stomach rupture when using the esophageal insertion technique (Carl Burger, pers. comm.; 1983). Four coho salmon were captured by seine net on August 2. Upon release, all four fish swam downstream. One fish was recaptured by an angler the following day at M.P. 28. Another coho migrated upstream 36 miles in 26 days before being recaptured in the sport fishery. The remaining two radio tagged coho were tracked downstream approximately 5 miles over a 7-day period. The transmitter signals were then lost and the two fish were not located again.

Ten coho were captured by gill net, radio tagged and released on August 2. On August 5 tracking personnel discovered two of these fish on the river bank, 0.4 and 3.7 miles downstream of the release site. Cause of death could not be determined because birds had eaten away the entire peritoneal cavity area of both fish. One of the transmitters had been pulled from the cavity and was found 45 feet from the carcass. The second transmitter was found laying in the empty body cavity. Five fish had dropped between 0.6 and 10.8 miles downstream while one coho was located 1.0 mile above the release site within 48 hours after release. Signals from two transmitters were not located. The number of transmitters which could not be located increased during subsequent tracking surveys over the next 2 weeks. Tracking surveys were terminated on August 30 when the locations of only two of the 11 remaining transmitters were found. None of the radio-tagged coho captured by gill net were recaptured in the sport fishery.

No conclusions or statements can be made regarding the results of the Petersen disc or radio telemetry studies in 1983 because of inadequate sample sizes in both studies. However, from the available data, it appears that coho salmon are very susceptible to handling and tagging stress during the period when they first re-enter fresh water.

Fishwheel, hook and line and gill nets have been used to capture adult coho salmon in the lower river. Capture by fishwheel is considered the least stressful method, while gill nets are felt to induce the greatest stress on the fish. The percentage of coho recaptured in the sport fishery, which may be reflective of survival rates, was 9.5, 7.5 and 0% for coho captured by fishwheel, hook and line and gill net, respectively.

Coho salmon which received a radio transmitter were subjected to additional tagging stress. Experimental radio-tagging studies were conducted on coho salmon in Meadow Creek at the Big Lake Hatchery to determine the least stressful tagging technique. All coho used in the study were males and were in advanced stages of sexual maturation. Only fish tagged using the esophogeal insertion technique continued migrating above the release site. Three coho anesthetized and tagged esophogeally and three tagged esophogeally without anesthetic were observed above the weir site. No surgically-tagged coho were found above the weir. It appears that the esophogeal insertion technique is less stressful to coho salmon and allows more normal behavior after release than surgical techniques.

One coho tagged esophogeally without anesthetic was discovered dead on the streambed above the release site. Examination of the carcass revealed that the transmitter was still within the stomach and that the fish had spawned. Another coho, tagged surgically, moved 2 miles down Meadow Creek, across Big Lake and into Fish Creek within 48 hours after release within the weir structure. This fish was observed in spawning activity with a group of untagged coho during the next 7 days. Recovery and necropsy verified that the fish had spawned successfully.

On coho salmon tagged esophogeally, the antenna extended through the esophogeal spincter and into the mouth where it was attached to the roof of the mouth or jaw with a stainless steel fishhook. While these coho were observed within the weir structure it was noted that, on many of the fish, the hook came loose and hung free within 48 hours after release. Four transmitters were found on the streambed over the next several days. Presumably, the hook, which dangled free outside the mouth, became caught on submerged roots, vegetation and other objects and pulled the transmitter from the fish's stomach. During later seining operations several transmitters were pulled loose when the hook became entangled in the net. One transmitter was found on the streambed of Meadow Creek 1.5 miles above the weir, immediately below a beaver dam. The hook, had it been loose, probably caught on a piece of wood in the dam as the fish was trying to ascend it and the transmitter was pulled out. The radio tagged coho recaptured by an angler near the Parks Highway on the Little Susitna River also had the antenna hook loose. However, the hook had broken midway down the shank so it could not become caught as easily. This may partially explain why this coho was the only fish known to reach the upstream area with the transmitter still intact.

Other coho telemetry researchers in Alaska have experienced problems with excessive transmitter loss (Carl Burger, pers. comm., 1982). In every study, fishhooks were used to attach the external antenna to the roof of the mouth. This transmitter loss was attributed to tag regurgitation, but the Meadow Creek observations indicate the loss may have resulted from the hook coming free and catching on some object. During future telemetry studies on Little Susitna coho, the antenna will either be left loose in the fish's mouth or will be attached to the jaw with a jaw clamp.

Coho at Meadow Creek did not struggle as much during capture and tagging as coho in the lower portion of the Little Susitna River. The Meadow Creek fish recovered much more quickly in the holding pen and resumed normal swimming behavior and initial upstream movement within minutes after tagging. Little Susitna coho required a longer recovery period and would remain in the release area or drift downstream after release. Upstream migration did not continue for several hours or days. This difference in recovery may be due in part to the relative physiological conditions of the fish. Coho captured in the lower reaches of the Little Susitna had just re-entered fresh water and their energy reserves were at their peak. They were also undergoing physiological changes that occur during transition from salt to fresh water. In addition, many of the normal body functions began to terminate at this time to direct all of the energy reserves toward development of sexual gametes and spawning activity.

The coho salmon at Meadow Creek had already migrated over 18 miles above the intertidal area and presumably had readjusted to the fresh water environment. Their energy reserves were partially depleted and since they struggled less, they were not subjected to as much stress during capture and tagging.

Although much stronger, coho salmon which have just re-entered fresh water seem to be very fragile. Capture and tagging techniques should be designed to reduce stress to a minimum to ensure maximum survival and more normal behavior after release.

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